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Overstaying Guest Workers and the Incentives for Return

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Abstract

A guest-worker program can be a very flexible and convenient way of meeting labor shortages in a host country, assuming that the migrants adhere to the rules of the program. This article investigates the conditions under which guest workers have sufficient incentives for voluntary return to their country of origin when their work permits expire. Should they choose to overstay, the article examines how various factors influence the optimal duration of the overstay phase of a foreign worker's planning horizon. The analysis is conducted in the context of a lenient enforcement regime that avoids deportations of undocumented aliens. It relies instead on eligibility criteria and pricing instruments, such as partial withholding of salary and an exit tax for those who overstay, to provide incentives for voluntary return at the end of the contract period. (JEL code: F22)

Keywords: temporary migration, overstaying, voluntary return, guest workers, retirement benefits

1 Introduction

Guest-worker programs of various shapes and forms have been utilized extensively since World War II to meet shortages of low- and semi-skilled labor in the advanced and rapidly growing emerging economies. The *Bracero* program (1942–1964), established to recruit Mexican workers for temporary employment in the USA., is one of the early examples. In the 1960's and 1970's, Western European countries introduced temporary migration schemes to meet the growing demand for labor in the manufacturing sector. Following the oil price shock of 1973, these schemes were wound down. At the same time, the oil-producing countries in the Middle East, especially those with a small indigenous labor force, expanded their temporary migration programs to the point where foreign workers now account for most (and in some exceptional cases practically all) of the work force in the private sector (see Kapiszewski 2006). Rapid growth in East Asia also generated labor shortages in the late 1980's and 1990's. In the case of South Korea, Taiwan, Hong Kong, Singapore, Brunei, Japan, Thailand, and Malaysia, these shortages have been addressed by recruiting temporary foreign workers or trainees to work in small-scale manufacturing, construction, agriculture, food processing, and various labor-intensive service activities.

Temporary migration is an attractive mode of international labor mobility for the host countries. It enables them to meet labor shortages without having to make long-term commitments to foreign workers with respect to permanent settlement, political rights, and access to social programs. At the same time, temporary migration schemes offer much greater labor-market flexibility than permanent migration programs.[1] An important concern for the policymakers, however, is that the migrants may not choose to go back when their work permit expires. As pointed out by Millbank (2006), a major problem that host countries have to deal with is that guest workers who agree initially to the program rules may decide to overstay. In East Asian economies, as well as in some of the labor-importing countries of the Middle East, *permanent* settlement of foreigners who were admitted as *temporary* low-skilled workers is a critical issue for the authorities. They fear that it can have an irreversible impact on the ethnic composition of the population, threaten the country's cultural homogeneity, and adversely affect the political and economic status of the natives. By contrast, the states in Western Europe and North America are less alarmed by the prospect of a temporary migrant trying to remain in the country permanently. Yet, even in these relatively more permissive immigration regimes, the authorities are becoming increasingly vigilant when it comes to enforcing legislation pertaining to illegal immigration.[2]

East Asian economies have addressed the problem of overstaying guest workers, in part, by applying very strict deportation measures. These measures, however, can be very costly in economic terms.[3] They are also costly in terms of a country's human-rights image, as deportations are sometimes fiercely resisted by the deportees, resulting even in fatalities

[1] Ethier (1985) provides a pioneering analysis of the welfare implications of guest-worker migration in a model of international trade. See also Schiff (2007, 2011 unpublished manuscript), Winters et al. (2003), Djajić (2013), Djajić et al. (2012), and Djajić and Michael (2013) for theoretical treatment and GAO (2006), Martin (2003), Martin and Titelbaum (2001), Abella (2006, 2009), Hahn and Choi (2006), Park (2008), Satoshi (2008), and Ruhs (2005) for more descriptive analysis. An extensive discussion of the successes and failures of temporary migration programs in the past is provided by Ruhs (2002). Orranius and Zavodny (2010), Djajić (2011), and Peri (2012) offer suggestions for reforming the current system in the USA.

[2] Throughout the article, we shall assume that a goal of the authorities of the host country is to minimize the number of guest workers who overstay. As noted by a referee, such an objective may not always be in the economic interest of the host country.

[3] According to the Associated Press (2011), the cost of apprehending, processing, detaining, and deporting an illegal alien in the USA is estimated to be $12,500 per person. In the UK, between 1998 and 2009, 111,265 illegal immigrants have been deported at the average cost of £11,000 per person (BBC 2009). In Norway, as reported by Berglund (2013), each deportation costs on average NOK 50,000 (USD 9000). This is due to the required paperwork and transport involved, often including police escorts.

related to the procedure. Advanced Western countries are therefore rather reluctant to resort to deportations. Notable exceptions are cases of illegal aliens who have completed serving a prison sentence related to criminal activities.[4]

Under the assumption that the authorities of the host country avoid relying on deportation measures, this article analyzes how various factors influence a guest worker's choice between returning voluntarily to the home country at the end of the contract or overstaying and becoming an undocumented worker in the underground economy of the host country. Should it be optimal to overstay under a given set of conditions, the study examines the impact of host-country policies on the optimal duration of the overstay phase of a migrant's planning horizon. The framework of our analysis is based on that developed in Section 2 of Djajić (2013). The present study differs, however, with respect to its objectives as well as in terms of the policy instruments assumed to be available to the authorities. The objectives are (i) to examine for the first time how immigration policies of the host country influence the optimal duration of the overstay period of a guest worker, when adequate incentives for voluntary return at the end of his/her contract are not in place and (ii) to characterize the policy environment that results in strict compliance with the program rules. By contrast, the focus of Djajić (2013) is on the conditions under which a guest worker prefers voluntary return at the end of the contact over a *permanent* overstay as an undocumented worker.

With respect to tools of immigration policy, we consider two additional policy instruments that can help induce guest workers to return home voluntarily at the end of their contract: (i) a penalty for having overstayed, which is imposed on an illegal alien when exiting the country and (ii) a salary withholding scheme.[5] Penalties for overstaying are very

[4] Due to budget cuts, noncriminal illegal aliens, awaiting deportation in the US detention system, were gradually being released in February 2013. According to Randy Beck, Justice Thomas O. Marshall chair of constitutional law at the University of Georgia, the problem is essentially financial: 'Look, we don't have the resources to deport everybody. We have to pick and choose and we're just going to choose people who have committed serious offenses' (Hamilton 2013).

[5] These instruments are also considered in Section 4 of Djajić (2013), although in a much simpler framework of analysis, which excludes, for instance, consideration of international price-level differentials, interest-rate differentials, and time discounting. Moreover, that previous work is based on the assumption that guest workers are paid wages that are substantially below those of native workers, which gives them an incentive to run away from their contractual employer. In the present study, we assume that guest workers and natives receive similar wages. Finally, in Section 4 of Djajić (2013), overstaying guest workers are assumed to face an environment in which a permanent overstay is optimal. They return to S only if deported by the authorities of H, as in Vinogradova (2014). In the present study, we assume that the authorities of H do not resort to deportation measures.

common in both Western and Asian countries. They often consist of monetary fines and/or other forms of punishment, such as a jail sentence or a ban on reentry, which may be for a specific period of time or permanent. We also extend the framework of analysis used in previous studies by considering explicitly the retirement phase of a worker's planning horizon and examining its role in influencing the optimal timing of return.

The remainder of the article has the following structure. Section 2 defines the maximization problem of a guest worker who intends to return voluntarily at the end of the contract period and of a guest worker who intends to overstay for an additional x units of time, where x is optimally chosen. In Section 3, discounted lifetime utility associated with these two choices is compared with that of a nonmigrant to characterize the conditions under which a temporary migration program is able to attract participants and induce them to return to their countries of origin when the work permit expires. Should it be optimal for a guest worker to overstay, our model relates the duration of the undocumented phase to the immigration policies of the host country and other parameters of the model that characterize the environment facing a foreign worker. Section 4 summarizes the main policy implications of the model.

2 A Guest Worker's Problem

Consider a two-country world consisting of a source country (S) and a host country (H). Suppose that H recruits workers from S on temporary contracts that require each migrant to work for his contractual employer for τ units of time. Some countries allow migrants to renew their work permits, provided the request is supported by the employer. This is still the case, for example, in most of the Gulf Cooperation Council states. In other countries, work (or trainee) permits of low-skilled migrants are non-renewable or can be renewed for only a specific period of time: the maximum duration of stay for low-skilled guest workers (or trainees) is 3 years in Japan, 4 years in Singapore and on Cyprus, 5 years in Israel and Malaysia, and 6 years in South Korea and Taiwan. In what follows, we shall assume that the work permits are valid for τ units of time, non-renewable, and made available to migrants at what we define to be the age of 0 (i.e. the beginning of the planning horizon).

To provide a strong incentive for contract completion *and* voluntary return to the source country, we assume that the employer withholds a fraction α of a migrant's wage for the entire duration of the contract period. The practice of withholding part of a worker's salary to guarantee contract completion has been common in the Middle East and East Asia. It was also required under the Bracero program, where the US

government withheld 10% of earnings in an effort to ensure that the Bracero workers were only temporary migrants.

Let us assume that the withheld earnings are returned to the migrant (with interest) at time τ, conditional on voluntary departure. Assuming that the salary withholding rate is smaller than a guest worker's optimal saving rate while abroad, a worker who intends to return to the source country at time τ is not affected by the withholding scheme. It essentially serves as a savings plan. The withholding measure bites only in the event the worker chooses to overstay.

Guest workers earn the foreign nominal wage, w^*, and the foreign rate of return, r^*, on accumulated savings (including withheld earnings). When a worker returns to S, she works for the wage $w(< w^*)$ and invests the repatriated savings in an activity that yields the rate of return $r > r^*$.[6] We shall assume that w^*, w, r^*, and r are all constant. At time T, a worker goes into retirement until the end of the planning horizon at $t = T + R$, where R is the duration of the retirement phase. Retiring in the country of origin is assumed to offer a flow of benefits which has a value of b. This flow may consist of public-sector transfers or it can be more broadly interpreted to represent returns on social capital that the migrant enjoys in her community of origin.[7]

2.1 A migrant who obeys the rules of the program

For a guest worker who intends to return voluntarily at the end of the contract period, the problem is to maximize V^m, the discounted utility from consumption abroad (from time 0 to τ) and at home (from time τ to $T+R$), by choosing the optimal consumption rate at each point in time.

$$\max_{c_t^*, c_t} V^m = \int_0^{\tau} u(c_t^*)e^{-\delta t}dt + \int_{\tau}^{T+R} u(c_t)e^{-\delta t}dt, \tag{1}$$

[6] Evidence on the rates of return on repatriated assets of returnees is scarce. Nonetheless, these rates seem to be (or should be) considerably higher than the rates available on savings in the host country (see, e.g. Penny 1986; Swallow and Brokken 1987; de Mel et al. 2008 and Udry and Anagol 2006).

[7] Pension systems in developing countries, to the extent they exist, tend to have very limited coverage. Supplementary private-sector programs are available in most countries, but they are typically aimed at the higher income segments of the work force and have little relevance for returning guest workers. Lack of fiscal resources, a large informal sector, lack of information on earnings, and financial constraints on workers that limit their capacity to contribute to pension schemes are some of the key problems that stand in the way of establishing broad public pension programs in the developing countries. By introducing b, what we have in mind is a minimum-pension program that unconditionally provides a pension to the elderly residents, regardless of income or work history, such as the programs in Bolivia, Botswana, Mauritius, and Namibia. Minimum pension schemes also exist in South Africa, Argentina, Brazil, Chile, Costa Rica, and Uruguay, although these are subject to means testing.

with c_t^* and c_t being the rates of consumption abroad and after return to S, respectively.[8] The migrant's rate of time preference, δ, is assumed to be constant and the utility function is concave, twice differentiable, and invariant with respect to the location where consumption takes place.

Utility is maximized subject to the budget constraint which requires that the savings accumulated abroad (including withheld wages), net of migration costs, plus any initial asset holdings, A_0, are equal to the appropriately discounted excess of consumption over wage income after return. The cost of migration is assumed to be a constant $K \leq A_0$.[9] Using the date of return τ as the point of reference, we may express a guest worker's budget constraint as follows:

$$\int_0^\tau (w^* - p_t^* c_t^*) e^{r^*(\tau - t)} dt - (K - A_0) e^{r^* \tau} = -\int_\tau^T (w - p_t c_t) e^{-r(t-\tau)} dt - \int_T^{T+R} (b - p_t c_t) e^{-r(t-\tau)} dt, \tag{2}$$

where p_t and p_t^* are the prices at t of the unique consumption good available in both S and H, respectively.[10] The Lagrangian associated with this

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[8] If w^* and τ are large enough, a migrant may prefer to return to S before time τ (see Djajić 2010). For realistic values of the parameters that characterize the conditions facing guest workers, however, they typically wish to remain abroad until the completion of their contract. Cases of migrants returning to S *before* time τ usually occur as a result of unexpected developments at home or at the workplace. We shall exclude such cases by assumption.

[9] For a theoretical analysis of the problem facing migrants who are liquidity constrained and need to borrow funds to pay for migration costs, see Friebel and Guriev (2006) and Djajić and Vinogradova (2013, 2014).

[10] The budget constraint (2) reflects our assumption that α is smaller than the migrant's optimal saving rate while abroad. If α is larger than the optimal saving propensity, then the withholding scheme does represent an additional constraint in the migrants optimization program. We would then need to take it into account by introducing two budget constraints—one for the period $[0,\tau]$ and another for $(\tau, T+R]$—as follows:

$$\int_0^\tau [(1-\alpha) w^* - p_t^* c_t^*] e^{r^*(\tau - t)} dt - (K - A_0) e^{r^* \tau} \geq 0,$$

$$\int_\tau^{T+R} p_t c_t e^{-r(t-\tau)} dt - \left[\int_0^\tau \alpha w^* e^{r^*(\tau - t)} dt + \int_\tau^T w e^{-r(t-\tau)} dt + \int_T^{T+R} b e^{-r(t-\tau)} dt \right] = 0.$$

Solving for the optimal saving rate abroad, it turns out that the exact condition on α such that the withholding scheme does not represent an additional constraint for the migrant is that $\alpha < \overline{\alpha}$, where

$$\overline{\alpha} = \frac{\frac{(e^{g(T+R-\tau)}-1)}{g} \left(\frac{p^*}{p}\right)^{1/\theta - 1} - \frac{w(1-e^{-r(T-\tau)})}{w^* r} - \frac{b(e^{-r(T-\tau)} - e^{-r(T+R-\tau)})}{w^* r} + (K - A_0) e^{r^* \tau}}{\frac{(e^{r^* \tau}-1)}{r^*} + \frac{(e^{g(T+R-\tau)}-1)}{g} \left(\frac{p^*}{p}\right)^{1/\theta - 1}}.$$

Our numerical simulations suggest that for a very wide range of parameters this

maximization problem may be written as follows:

$$L = \int_0^{\tau} u(c_t^*)e^{-\delta t}dt + \int_{\tau}^{T+R} u(c_t)e^{-\delta t}dt + \lambda\left\{\int_0^{\tau}(w^* - p_t^*c_t^*)e^{-r^*t}dt - (K - A_0) + e^{-r^*\tau}\int_{\tau}^{T}(w - p_tc_t)e^{-r(t-\tau)}dt + e^{-r^*\tau}\int_{T}^{T+R}(b - p_tc_t)e^{-r(t-\tau)}dt\right\}$$

The first order conditions consist of

$$\frac{\partial L}{\partial c_t^*} = u'(c_t^*)e^{-\delta t} - \lambda p_t^* e^{-r^*t} = 0, \;\; t \in [0, \tau) \tag{3}$$

$$\frac{\partial L}{\partial c_t} = u'(c_t)e^{-\delta t} - \lambda p_t e^{-rt+(r-r^*)\tau} = 0, \;\; t \in (\tau, T+R] \tag{4}$$

and the budget constraint (2). Let us simplify the analysis by assuming that $\delta = r^*$ and that the prices of consumption abroad and at home are constant at the levels p^* and p, respectively. We can then write eqs. (3) and (4) as follows:

$$u'(c_t^*) = p^*\lambda, \tag{5}$$

$$u'(c_t) = p\lambda e^{-(r-r^*)(t-\tau)}. \tag{6}$$

We observe in (5) that $u'(c_t^*)$ is constant. The corresponding rate of consumption c_t^* is therefore also constant at c^*. It is realistic to assume that the price of the standard unit of consumption is higher abroad than it is at home (i.e. $p < p^*$). Equations (5) and (6) then imply that at time τ, return to S (where the price of consumption is relatively lower) triggers an upward jump in the consumption rate. Letting the utility function take the form $u(x) = x^{1-\theta}/(1-\theta)$, and using (5) and (6), we may write $c_\tau = c^*(p^*/p)^{1/\theta} > c^*$, which relates the magnitude of the jump in consumption to the ratio of the price levels and the degree of concavity of the utility function. Along with Equation (6), this implies that

$$c_t = c^*(p^*/p)^{1/\theta}e^{\left(\frac{r-r^*}{\theta}\right)(t-\tau)}, \quad t \in (\tau, T+R], \tag{7}$$

constraint is never binding. In fact, the value of $\bar{\alpha}$ is always well above 50% for the realistic calibrations that we use in our analysis. This is considerably higher than, for example, the 10% withholding rate of the Bracero program.

where $1/\theta$ is the elasticity of intertemporal consumption substitution. Using (7), the budget constraint (2) can be written as follows:

$$\frac{(w^* - p^*c^*)}{r^*}(e^{r^*\tau} - 1) - (K - A_0)e^{r^*\tau} - \frac{pc^*(p^*/p)^{1/\theta}}{g}(e^{g(T+R-\tau)} - 1) + \frac{w(1 - e^{-r(T-\tau)}) + b(e^{-r(T-\tau)} - e^{-r(T+R-\tau)})}{r} = 0, \tag{8}$$

where $g = [(r - \delta)/\theta] - r \gtreqless 0$. This yields the solution for c^* as a function of the model's parameters: migration cost, K, the maximum allowed duration of stay abroad, τ, the foreign and domestic wage rates, w^* and w, foreign and domestic commodity prices, p^* and p, initial asset holdings, A_0, the rate of return, r, on accumulated savings, the remaining working life, T, at the time of migration, and finally the duration of the retirement phase, R, and the flow of benefits, b, enjoyed by a retiree at home:

$$c^* = \frac{\frac{w^*(e^{r^*\tau}-1)}{r^*} + \frac{w(1-e^{-r(T-\tau)})}{r} + \frac{b(e^{-r(T-\tau)}-e^{-r(T+R-\tau)})}{r} - (K - A_0)e^{r^*\tau}}{\frac{p^*(e^{r^*\tau}-1)}{r^*} + \frac{p(e^{g(T+R-\tau)}-1)}{g}(\frac{p^*}{p})^{1/\theta}}. \tag{9}$$

Using Equation (9) in (7), and introducing the resulting expression into Equation (1) yields

$$V^m = \frac{(c^*)^{1-\theta}}{1-\theta}\left(\frac{1 - e^{-\delta\tau}}{\delta}\right) + \frac{(c^*)^{1-\theta}(p^*/p)^{\frac{1-\theta}{\theta}}}{1-\theta}\left(\frac{e^{g(T+R-\tau)-r^*\tau} - e^{-\delta\tau}}{g}\right). \tag{10}$$

With c^* given by (9), this is the discounted level of utility enjoyed by a guest worker who obeys the rules of the program and returns to S at $t = \tau$.

2.2 The problem facing an overstayer

If a guest worker remains abroad after the work permit expires at time τ, he/she forfeits the withheld wages, $\int_0^\tau \alpha w^* e^{r^*(\tau-t)}dt$, and faces a fine in the amount ϕ, should he/she try to exit the host country after having overstayed. Penalties for overstaying can take different forms: they can be pecuniary in nature and/or involve imprisonment, as in Saudi Arabia, Singapore, Malaysia, South Korea, and other Asian countries (see Vinogradova 2011), or they may take the form of a ban on reentry for a certain number of years, as for example, in Japan, the USA., and the states of Western Europe.[11] Regardless of the form of penalty, for it to be fully

[11] An individual residing unlawfully in the USA for more than 180 days, but less than one year, is barred from reentering for a period of 3 years. If the person is unlawfully present

effective, it must not exceed the cost of avoiding the penalty, should it be a fine or a prison term, by clandestinely exiting the host country. The cost of a clandestine exit can be very high, as in the case of Japan and South Korea, or much lower, as in countries with penetrable land borders, such as the USA. or the Schengen zone. In what follows, we shall assume that ϕ is below the cost of a clandestine exit.

As is the case in most countries, overstaying also implies that once the work permit expires at time τ, the migrant is obliged to seek employment in the underground economy and earns a lower wage: Not the wage w^*, but rather the wage $w^u = w^*(1-\sigma) > w$, where the fraction σ represents the wage penalty associated with having undocumented status in the labor market of the host country.[12] For the USA, studies conducted by Rivera-Batiz (1999, 2000) and Kossoudji and Cobb-Clark (2002) suggest that the wage penalty associated with undocumented status was roughly 20% in the 1990s. The wage penalty, σ, is likely to be higher in economies with stricter internal enforcement measures.[13]

Discounted utility, V^{OS}, of a guest worker who is determined to overstay in H for an additional x units of time can be obtained by solving the following optimization problem:

$$\max_{c_t^*, c_t, x} \; V^{os} = \int_0^{\tau+x} \frac{(c_t^{*os})^{1-\theta}}{1-\theta} e^{-\delta t} dt + \int_{\tau+x}^{T+R} \frac{(c_t^{os})^{1-\theta}}{1-\theta} e^{-\delta t} dt, \qquad (11)$$

for 1 year or more, upon departing, he or she becomes inadmissible for 10 years. Penalties for overstaying can take many different shapes and forms. In the case of New Zealand's temporary migration program, the so-called Recognised Seasonal Employer scheme, which recruits workers from a number of Pacific island economies, an effective penalty for overstaying can in fact be imposed by the community at origin. As pointed out by Gibson and McKenzie (forthcoming), competition for placement in the program among communities in the countries of origin gives rise to social pressures on migrants not to overstay, as that would create a negative reputation for one's community and jeopardize migration opportunities for other community members.

[12] A number of labor-importing countries in the Middle East and East Asia offer wages to foreign contract workers or 'trainees' which are in some cases a small fraction of the wage paid to native workers for similar work (See Section 4 of Djajić 2013 and Djajić and Mesnard unpublished manuscript). In such a regime, foreign contract workers and trainees have a strong incentive to run away from their contractual employer and look for work in the underground economy, where wages are *higher* than those paid to documented foreign workers. We ignore such regimes in the present study, focusing only on the case where documented foreign workers are paid wages which are similar to those earned by native workers in the same occupation.

[13] A guest worker's salary withholding rate, α, and the wage penalty for undocumented work, σ, have similar roles in the present model. They both make it less attractive to overstay. An important distinction between the two is that withheld salary represents a fixed cost of choosing to overstay, with the cost directly proportional to the withholding rate and the duration, τ, of the official employment contract. By contrast, we can think of σ as a 'variable' cost that eats away part of the benefits of overstaying at each instant over the entire overstay phase.

subject to

$$A_0 - K - \phi e^{-r^*(\tau+x)} + \int_0^{\tau} [w^*(1-\alpha) - p^* c_t^{*os}] e^{-r^* t} dt + \int_{\tau}^{\tau+x} [w^*(1-\sigma) - p^* c_t^{*os}] e^{-r^* t} dt + e^{-r^*(\tau+x)} \int_{\tau+x}^{T} [w - p c_t^{os}] e^{-r(t-\tau-x)} dt + e^{-r^*(\tau+x)} \int_{T}^{T+R} [b - p c_t^{os}] e^{-r(t-\tau-x)} dt = 0, \tag{12}$$

where c_t^{*os} and c_t^{os} are the consumption rates abroad and at home of a worker who intends to overstay in H, with the duration of the undocumented stay, x, optimally chosen. This problem has a number of features similar to the one examined in the Appendix of Djajić (2013). In the present study, however, we consider a richer policy environment that includes withholding of wages, which are forfeited if the migrant does not leave at the end of the contract period, and a penalty for violating the rules of the program that consists of a fine, ϕ, if and when the worker decides to exit the host country. Relegating the somewhat tedious algebraic steps required for the solution of this problem to the Appendix A.1, we simply define here V^{OS} to be the discounted welfare of a guest worker who overstays in H until he/she finds it optimal to return to S. In Section 3, we will study the conditions under which a guest worker has no incentive to overstay and examine how the *optimal duration* of the undocumented phase is affected by the immigration policies of the host country and other parameters that influence a migrant's behavior.

2.3 Utility of a nonmigrant

If a worker chooses not to migrate, his/her problem is to

$$\max_{c_t^n} V^n = \int_0^{T+R} \frac{(c_t^n)^{1-\theta}}{1-\theta} e^{-\delta t} dt \tag{13}$$

subject to the budget constraint

$$A_0 + \int_0^{T} (w - p c_t^n) e^{-rt} dt + \int_{T}^{T+R} (b - p c_t^n) e^{-rt} dt = 0, \tag{14}$$

where c_t^n is a nonmigrant's consumption rate.

Following the usual steps of the optimization program, we find that

$$c_t^n = c_0^n e^{\frac{r-\delta}{\theta} t} \text{ and } c_0^n = \frac{[A_0 + \frac{w}{r}(1 - e^{-rT}) + \frac{b}{r}(e^{-rT} - e^{-r(T+R)})]g}{p(e^{g(T+R)} - 1)}, \tag{15}$$

and the discounted lifetime utility

$$V^n = \int_0^{T+R} \frac{[c_0^n e^{\frac{r-\delta}{\theta}t}]^{1-\theta}}{1-\theta} e^{-\delta t} dt = \frac{(c_0^n)^{1-\theta}}{1-\theta} \frac{(e^{g(T+R)}-1)}{g}, \tag{16}$$

with c_0^n given by (15) and $g = \frac{(r-\delta)}{\theta} - r \gtreqless 0$.

3 Temporary Migration with No Overstays

The objective of this article is 2-fold. To examine the conditions under which temporary migrants, who are recruited on a contract of the duration τ, have no incentive to overstay and, second, to study the relationship between immigration policies and the optimal duration of the overstay period if the incentives for voluntary return happen to be inadequate. In addressing these related problems, we compare the discounted utility of a temporary migrant who abides by the rules of the program, with those of a nonmigrant and of a guest worker who intends to overstay in H as an illegal alien for x additional units of time, where x is optimally chosen. From an expositional point of view, it is most illuminating to examine this problem by means of numerical simulations, using a specific example. Our choice of parameter values for this exercise is intended to reflect the conditions facing migrants from South and South-East Asia who work on temporary contracts in the manufacturing, construction and various service sectors of the economies in East Asia at wages comparable to those earned by similarly qualified native workers.

Without any loss of generality, we normalize w, the wage per year in S, and the country's price level, p, to unity. For the benchmark case, we assume that $r^* = \delta = .04$ per year, $r = .06$, and $\theta = 0.95$.[14] Working life, T, from the time of migration is set at 40 years, and the retirement period R is assumed to be 10 years, with retirement benefits, b, enjoyed by a returnee in the source country set equal to 50% of w. The cost of living in H is assumed to be twice as high in relation to that in S ($p^* = 2$), initial liquid asset holdings are assumed to be equivalent to 2 years of wages in S ($A_0 = 2$), the salary withholding rate of a guest worker is 10% ($\alpha = 0.1$), the wage of an illegal alien in H is assumed to be 20% lower than that of a documented guest worker ($\sigma = .20$), the penalty for overstaying is assumed to be 10% of a guest worker's yearly earnings in the host country

[14] Most estimates of θ seem to be in the range of 0.5 to 1.5 (see, e.g. Hansen and Singleton 1982; Keane and Wolpin 2001; Vissing-Jorgensen 2002; Favero 2005 and Kirdar 2012]. Values of θ in the range between 0.9 and 1.0 tend to generate, however, the most realistic patterns of saving behavior of temporary migrants (see Djajić 2010).

($\phi = 0.1$), and the cost of migration is equivalent to 2 year's wages in S ($K = 2$).[15]

The MO schedule in Figure 1 traces the combinations of τ and w^*, with other parameters at their benchmark levels, such that a migrant is indifferent between voluntarily returning to S at $t = \tau$ and overstaying beyond the expiration of the work permit for x additional years, where x is optimally chosen. Thus, at each point along MO, $V^m = V^{os}$. The schedule is positively sloped because an increase in w^* makes overstaying more attractive, whereas an increase in the legal duration of stay in the host country reduces the incentive to overstay. This is not only because the amount of withheld wages that are lost by an overstayer increases with the duration of a guest-worker's contract, but also because a larger τ enables a migrant to save more while legally employed abroad. This reduces the incentive to stay still longer in the foreign country. Anywhere above (below) the MO schedule, overstaying yields a higher (lower) level of discounted utility than does a voluntary return to S at the end of the contract period. The optimal duration of the overstay phase, x, associated with each point on MO is displayed by the X locus in the panel below. As an example, consider a point on the MO schedule such that $w^* = 2.6$ and τ roughly equal to 3. At this point, the migrant is indifferent between (i) complying with the rules of the guest-worker program, which offers a 3-year contract at $w^* = 2.6$ and (ii) initially working as a guest worker in H for 3 years and then foregoing the withheld wages to overstay in the underground economy for 7 additional years, pay the exit fine and return to S. The duration of overstay is positively related to the foreign wage along the MO schedule, as higher combinations of w^* and τ along MO make it attractive to overstay for a longer period of time. For combinations of w^* and τ to the *left* of MO, the optimal duration of overstay is *longer* than the one indicated on the X schedule at the corresponding value of w^*.

The MN schedule illustrates combinations of τ and w^* such that $V^m = V^n$. Thus, at any point along MN, workers in S are indifferent between migrating according to the rules of the guest-worker program and not migrating at all. The slope of MN is negative because an increase in τ makes M more attractive in relation to N in the relevant range, requiring a lower w^* to keep $V^m = V^n$.[16] Anywhere above the MN

[15] This is the amount, for instance, in the case of Thai migrants recruited on 2-year contracts in Taiwan (see Jones and Pardthaisong 1999). As noted in the Human Development Report (2009, p. 54), the recruitment fees for temporary employment contracts overseas can be an even larger multiple of source-country earnings.

[16] Djajić (2010) shows that, depending on the parameters of the model, there may exist a large enough, critical value of $\tau = \overline{\tau}$, such that an increase in the duration of stay abroad above $\overline{\tau}$ makes a migrant worse off. Values of τ which are relevant for most guest-worker

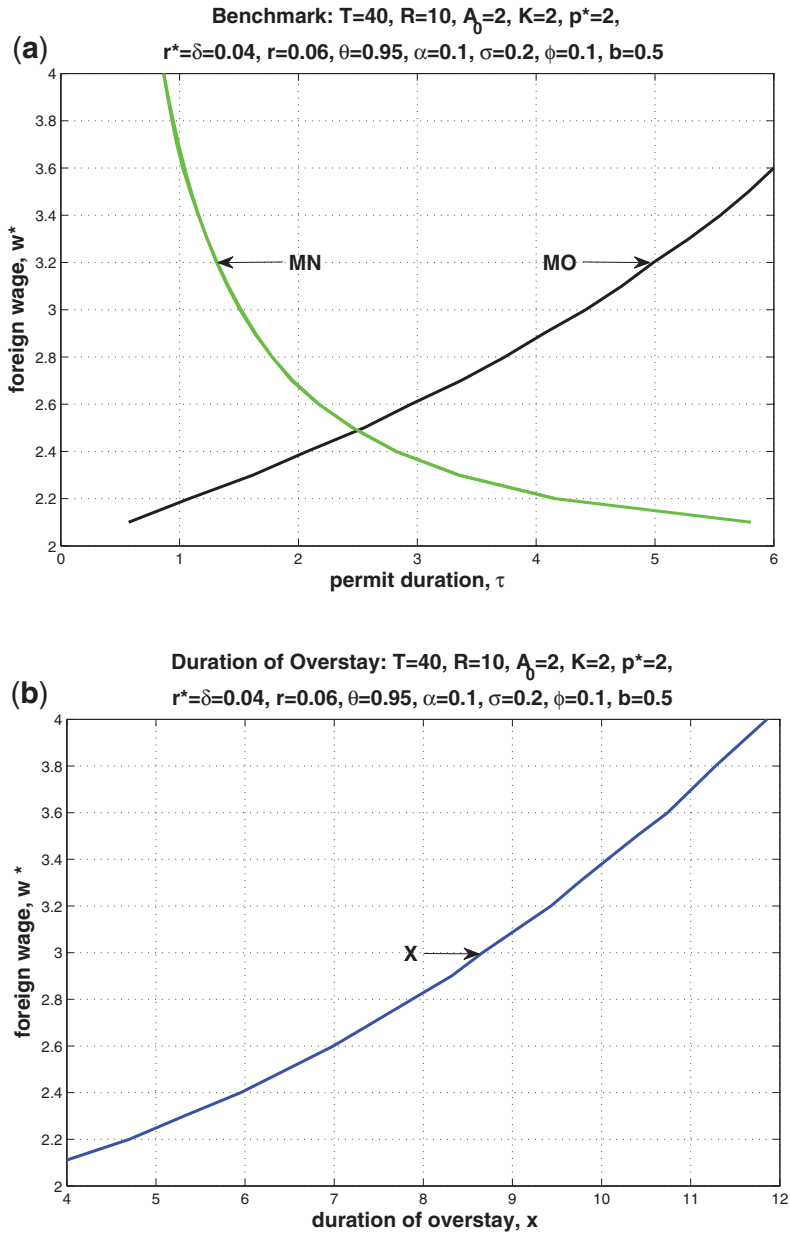

Figure 1 The choice of migration options and the optimal duration of overstay.

programs around the world, and hence the values we consider in the present study, are below $\bar{\tau}$.

locus, it pays to go abroad as a rule-abiding guest worker. Below the locus, workers prefer to stay permanently at home.

The two schedules divide Figure 1 into three regions of interest to us in the present study. In the region below the MN locus, the foreign wage and/or the legal duration of stay in H is not sufficient to induce migrants to go abroad and abide by the rules of the guest-worker program. For combinations of w^* and τ in the region to the left of MO and above MN, it pays to migrate as a guest worker, but it is even better to subsequently overstay and work in the host country without documentation. Finally, for combinations of w^* and τ in the region to the right of MO and above MN, it is optimal to migrate and strictly comply with the rules of the guest-worker program. Thus, in both panels (a) and (b), the relevant combinations of w^* and τ in the discussion that follows are those above the MN schedule.

It is also worth noting that for parameter values in the benchmark case and the ranges of w^* and τ displayed in the figure, it does not pay for a migrant to overstay permanently in the host country. It is clear that if we were to consider higher values of w^*, we would eventually arrive at the corner solution where an overstay for the entire working life of an individual is optimal. Alternatively, reducing the assumed value of p^* (or changes in other parameters) can result in a permanent overstay being optimal. In the analysis below, our focus is on interior solutions.

4 Incentives for Strict Compliance

We consider next the role of immigration policies, focusing on the extent to which they strengthen the incentives for strict compliance on the part of workers. Should the incentives prove to be insufficient, resulting in guest workers choosing to overstay, we examine the implications of each policy for x, the optimal duration of the overstay phase of a worker's planning horizon. It is important to note that we are not considering here the implications of *unanticipated* changes in policies. Every policy change is thus assumed to occur at the very beginning of an individual's planning horizon and is expected to be permanent.

4.1 Role of immigration policies

Wage penalty

Consider the impact of tightening internal enforcement aimed at employers of undocumented aliens. To the extent that such measures are effective, they will tend to manifest themselves in the form of an increase in the wage penalty, σ, facing undocumented workers. An increase in σ from 0.2 to 0.3 is shown to shift the MO schedule up and to the left in panel (a) of Figure 2. This signifies that if a migrant was initially indifferent between

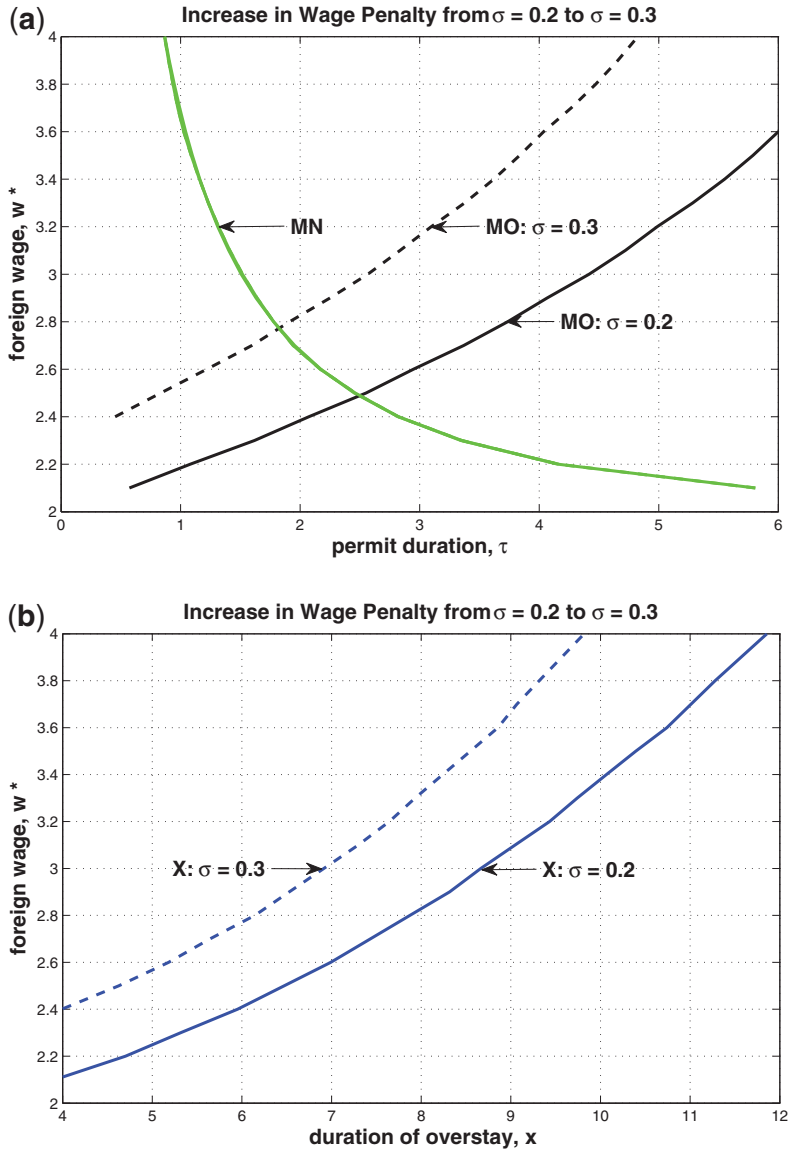

Figure 2 Effects of stricter internal enforcement measures.

overstaying and voluntarily returning for a given combination of w^* and τ, he/she now prefers to return voluntarily. This is because a larger wage penalty makes the overstay option relatively less attractive when compared to voluntary return. Since an increase in σ has no effect on the behavior of nonmigrants and of documented guest workers who intend

to return to S voluntarily at the end of their contract, the position of the MN schedule remains unchanged.

In panel (b) below, we also observe a leftward shift of the X schedule, indicating that the optimal duration of the overstay is shorter with a larger σ for each value of w^* along the new MO locus. The intuition here is very similar to that pertaining to the analysis of the optimal timing of return of documented workers, originally analyzed by Djajić and Milbourne (1988). Other things being equal, lower expected earnings over the overstay phase tend to reduce the benefit of overstaying an extra instant. This calls for adjustments in consumption and in the duration of the overstay phase to equalize once again, in terms of utility, the cost and the benefit of overstaying an instant longer and to ensure that the budget constraint is satisfied. A lower time path of consumption and a shorter overstay phase is optimal in this instance.[17] Thus, an increase in σ serves to (i) strengthen the incentives for strict compliance with the rules of the guest-worker program and (ii) should a worker, nonetheless, decide to overstay, it reduces the optimal duration, x, of the undocumented phase of her planning horizon.

Withholding rate

Consider next the impact of a higher salary withholding rate. An increase in α from 0.10 to 0.15% of a contract worker's salary makes it less attractive to overstay, as the loss of wages for any given combination of w^* and τ is greater. This implies that the MO schedule shifts up and to the left, as illustrated in panel (a) of Figure 3. The MN locus remains unaffected because the withholding scheme affects only those who overstay. Should the now higher withholding rate still happen to be insufficient to induce strict compliance on the part of guest workers [i.e. for combinations of w^* and τ in the 'Overstay' region above the MN schedule and to the left of MO in panel (a) of Figure 3], a higher withholding rate actually gives an incentive to those who overstay to do so for a *longer* period of time. This is shown by the rightward shift of the X locus in panel (b) below: an overstaying worker remains unambiguously longer in H, the larger the loss of

[17] As noted by Djajić and Milbourne (1988), if the degree of concavity of the utility function is sufficiently high, theoretically one cannot rule out the possibility of a longer planned duration of stay being optimal as a result of a cut in expected earnings abroad. When the degree of concavity is high, a small cut in consumption can be sufficient to generate the required increase in the utility value of savings resulting from overstaying, to equalize the cost and the benefit of overstaying an extra instant, as required by condition (20) in the Appendix. With a sufficiently small cut in consumption being the optimal response to a reduction in expected earnings abroad, the budget constraint may well call for a longer optimal duration of the overstay phase. For the parameter values of our benchmark case, however, we are far from obtaining such an outcome.

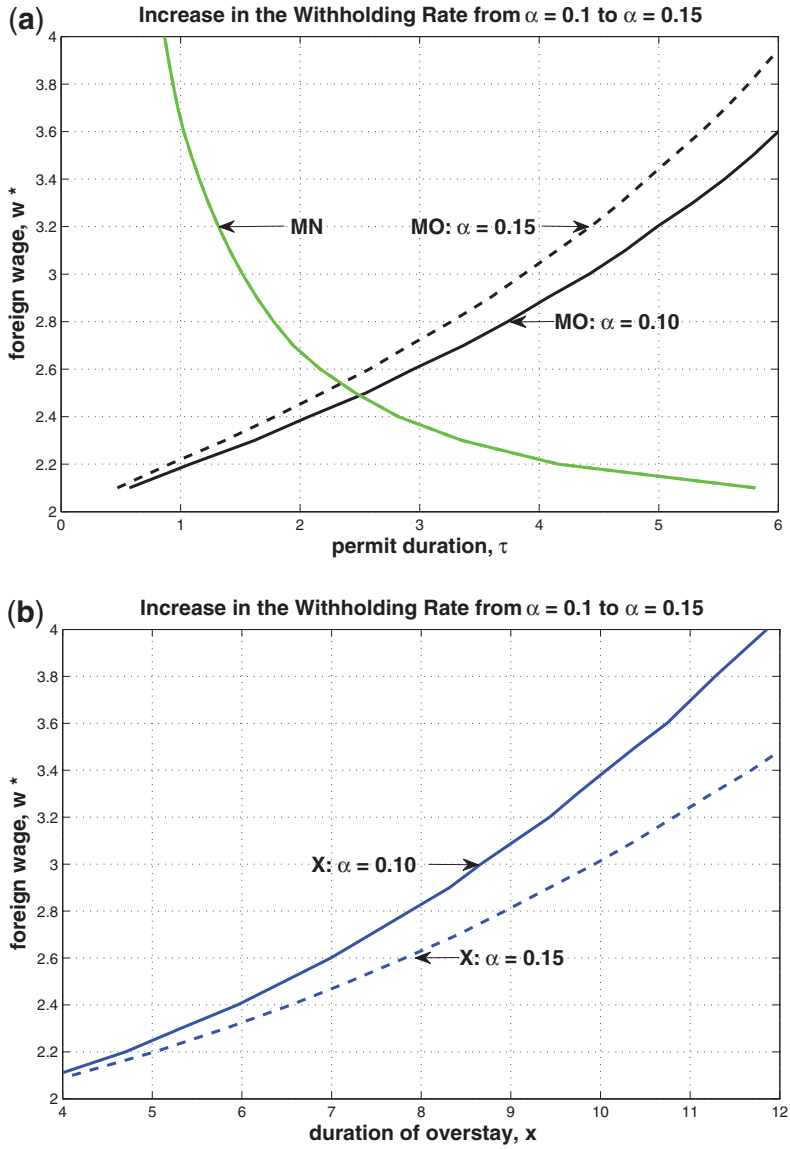

Figure 3 Effects of an increase in the withholding rate.

withheld wages, other things being equal. This finding can be better understood by examining in the Appendix the optimality condition for the termination of the overstay phase, as stated in Equation (20). The withholding rate α does not have any *direct* effect on the cost *vs* benefit of staying an instant longer as an undocumented alien in the host country.

It does have a direct impact on the budget constraint, however, making a longer overstay necessary to meet the cost of the optimal consumption program. This results in a higher value of x being optimal at any given w^* along the MO schedule.[18]

Fine for overstaying

An additional penalty for overstaying in the form of an exit fee operates in the same manner. It imposes an extra financial burden on an overstaying migrant and induces those who overstay to do so for a longer period of time. Still, an increase in ϕ provides a foreign contract worker with a stronger incentive for strict compliance with the rules of the program. It therefore shifts the MO schedule up and to the left, as in the case of an increase in the withholding rate, depicted in panel (a) of Figure 3.

These findings have important implications for policy: (i) They establish that increases in the salary withholding rate or in the overstay penalty in the form of a monetary fine can deter guest workers from overstaying. In this sense, they help address the problem of illegal immigration. (ii) Should these measures fall short of being *sufficient* to induce strict compliance on the part of participants, they turn out to be counterproductive: they contribute to an expansion in the stock of undocumented aliens employed in the economy. In such cases of insufficiency, marginal increases in the levels of α and/or ϕ *do not* serve to reduce the flow of guest workers transiting to undocumented status, but they *do* increase the duration of the undocumented stay of those who do not comply. This effectively generates a larger equilibrium stock of undocumented workers. In summary, salary withholding schemes and overstay penalties must be carefully set in relation to the environment that guest workers face at home and abroad to be effective in *reducing* the stock of undocumented foreign workers. By contrast, as we have seen in the preceding discussion on employer sanctions and the implied wage penalty in the underground economy, an increase in σ unambiguously reduces the stock of illegal aliens, regardless of the initial value of that instrument.

Migration costs

Let us examine next the implications of a reduction in the pecuniary cost of migration facing a guest worker, such as the cost of an entry visa, recruitment fees, or even in the tax imposed by H on the country's employers seeking authorization to hire guest workers. Such taxes are typically passed on to the workers in the form of a higher recruitment fee.

[18] This finding has fundamentally the same basis as the discussion in Djajić (2001) on the relationship between the cost of illegal entry and the duration of an undocumented migrant's stay in the host country.

The downward shift of the MN schedule in panel (a) of Figure 4 shows that a reduction in K from 2- to 1-year's worth of source-country earnings makes migration more attractive relative to a permanent stay at home. A lower migration cost also enables a guest worker to attain larger holdings of accumulated assets during her documented stay in H, for any given values of w^* and τ. This reduces the need for a guest worker to overstay, shifting the MO locus up and to the left. Note, in addition, that if K is lower, those who overstay do so for a shorter period of time, as shown by the leftward shift of the X locus in panel (b) of Figure 4. The intuition behind this result is the same as before. Lower migration costs relax a migrant's budget constraint and reduce the optimal duration of the overstay phase of the planning horizon.[19]

4.2 Role of the economic environment: return on savings, the price level, and initial assets

As we turn to the economic environment facing a migrant at home and abroad, we find that a higher rate of return, r, on investments at home shifts the MN schedule in Figure 5 down and to the left, as it makes migration more attractive relative to staying at home. Migration is for the purpose of asset accumulation, which is relatively more beneficial to a migrant when r is greater (Djajić 2010).[20] By contrast, a larger cost-of-living differential between the host and the source country (i.e. a higher p^*) makes migration relatively less attractive by imposing a higher cost of consumption abroad. In Figure 6, this implies a shift of the MN schedule up and to the right. Note, however, that both an increase in r and an increase in p^* serve to strengthen the incentives for strict compliance on the part of guest workers. They both make it more attractive to go back to the source country at the end of the contract, because a higher return on repatriated savings is now available in that location and the price of consumption is relatively lower. This is shown by the leftward shift of the MO schedule in panel (a) of Figures 5, where r is raised from 6 to 8% and in Figure 6, where p^* is raised from 2 to 2.2. Moreover, a higher return on investments at home and a larger international price differential do not only make the incentives for strict compliance stronger, but they also raise the cost of overstaying an extra instant relative to the benefit. This calls for

[19] See Djajić and Milbourne (1988) on the relationship between migration costs and the optimal timing of return for temporary migrants.

[20] If an individual's initial asset stock is above a certain critical level, it is more attractive to remain in S and enjoy the rate r ($> r^*$) on those asset holdings, rather than to go abroad where the wage is relatively higher. In such cases, an increase in r makes staying at home even more attractive. We assume that for those contemplating becoming a guest worker abroad, initial asset holdings are not above this critical level.

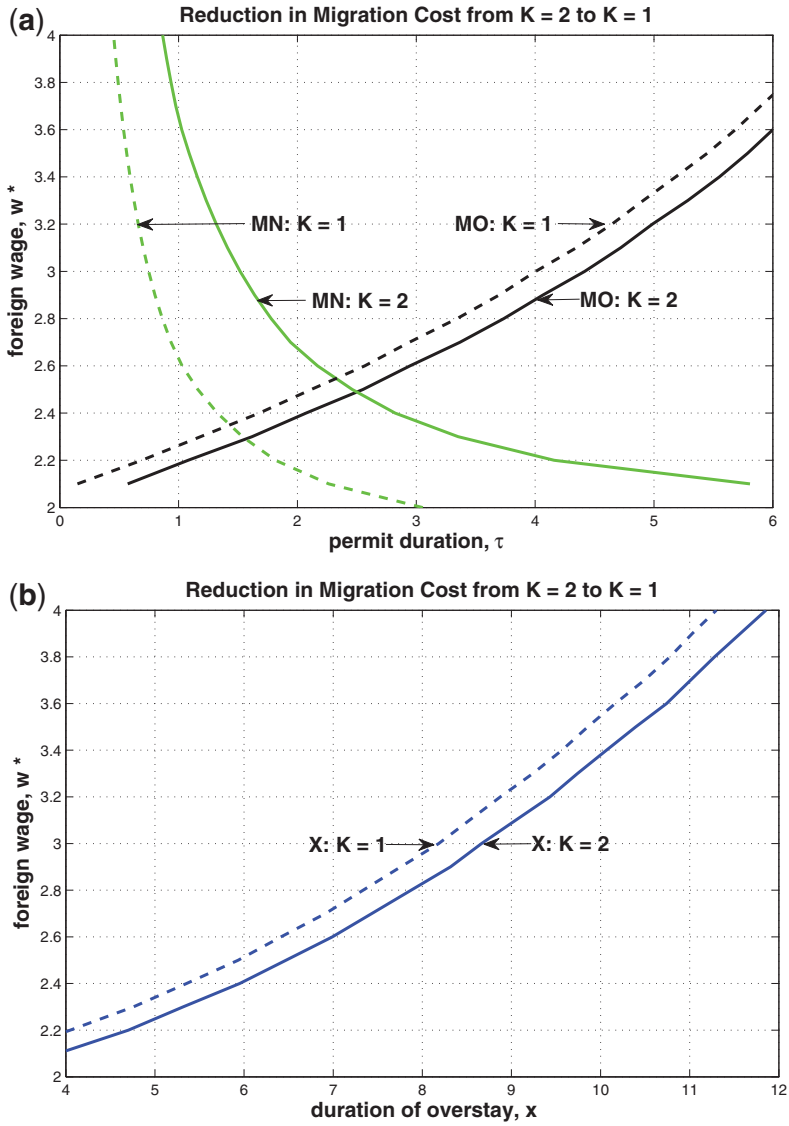

Figure 4 Implications of a reduction in migration costs.

a shorter optimal duration of an overstay, should the incentives for strict compliance prove to be insufficient: The X locus in panels (b) of Figures 5 and 6 shifts to the left.

This analysis confirms the findings of Schiff (2007) and Djajić (2013) that successful management of a guest-worker program hinges to a

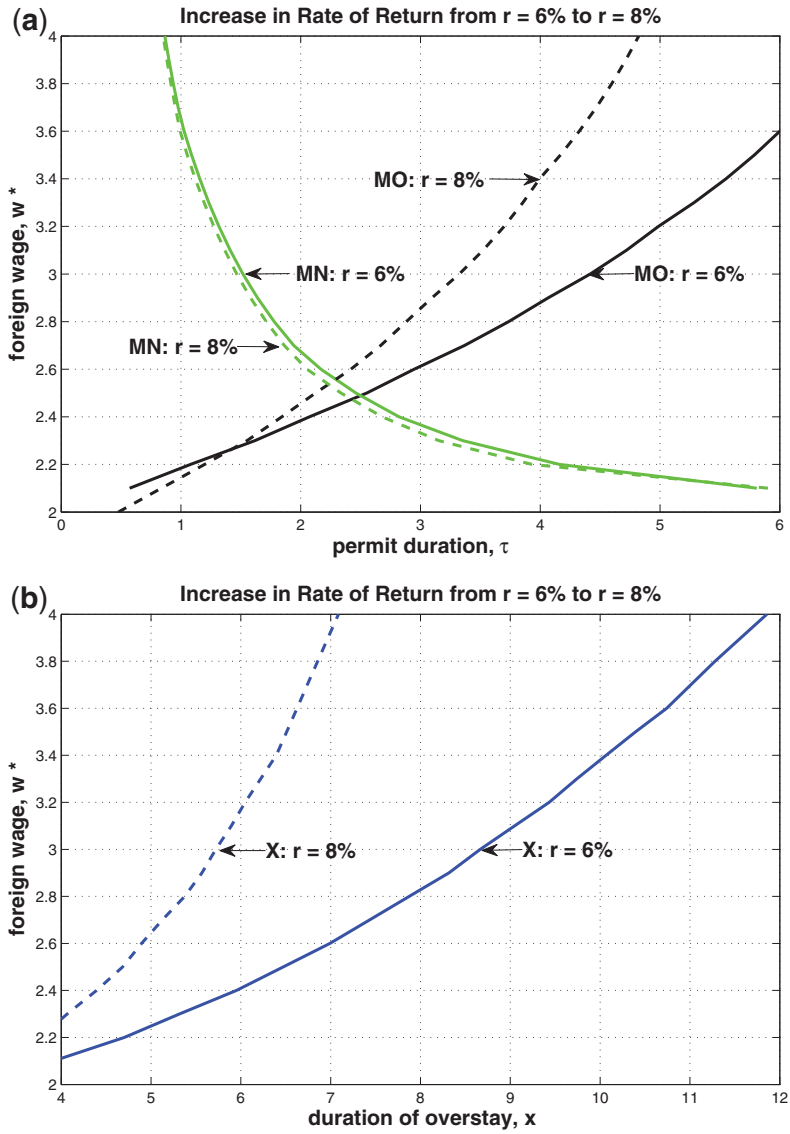

Figure 5 Implications of a higher rate of return on repatriated savings.

significant extent on the economic conditions in the countries of origin of program participants. A higher expected rate of return on repatriated assets and a higher foreign price level both serve to attract migrants back home. Selection criteria that give preference to migrants from countries characterized by a relatively high r and/or a larger price differential

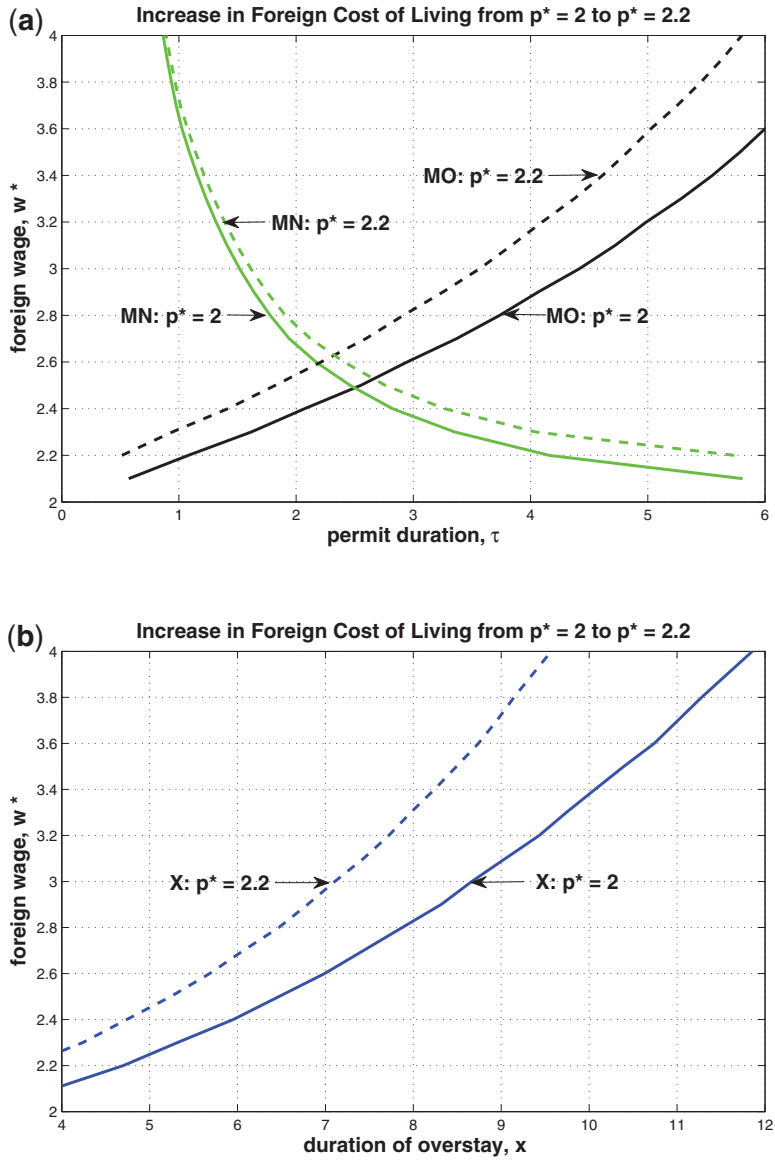

Figure 6 Implications of a higher price level in the host country.

between the host and source countries can (other things being equal) help reduce the number of guest workers who choose to overstay. The new finding here is that workers from such countries not only have greater incentives to comply with the rules of the program, but should they choose not to return home as scheduled, the optimal duration of their overstay

phase is relatively shorter. Similarly, as noted by Djajić (2013), guest workers who have larger initial asset holdings are less inclined to overstay. We can now add that if a worker with relatively larger initial asset holdings does choose to overstay, he/she will do so for a shorter period of time.

4.3 The retirement phase and benefits

Introducing the retirement phase into the model serves to strengthen a worker's motive to migrate with a view of accumulating assets for the purpose of supporting consumption during retirement at home. The longer the retirement phase, the greater the need for accumulated savings, as a worker's income (other than from accumulated assets) is assumed to drop to the level of retirement benefits, b, after time T. This can be seen in panel (a) of Figure 7, where the MN schedule shifts down and to the left if we increase R from 10 to 20 years. The incentive to overstay is similarly stronger for the same reason, as reflected in a shift to the right of the MO locus in panel (a) and the X schedule in panel (b). A longer retirement phase requires that earnings over the T working years of the planning horizon be spread to cover consumption over a longer lifetime. This gives guest workers a stronger incentive (i) to overstay rather than to return at the end of the contract and (ii) to overstay for a longer period of time.

Retirement benefits at home, with their money value reflected in the flow b in our model, help offset the need for greater asset accumulation that made the incentives for migration and overstaying stronger with an increase in R. An increase in b therefore has the opposite effect (not shown) on the MN and MO schedules. Recruitment of guest workers from countries with more generous retirement benefits and other social programs that reduce the need for personal savings to pay for consumption over the retirement phase should therefore help host countries lower the number of guest workers who overstay and reduce the average duration of the overstay phase of those who do not comply with the rules of the program.

Our modeling of the retirement phase is admittedly very simple. Every source country worker is assumed to be entitled to the same benefit b regardless of whether and how long she has worked abroad. If we were to consider in a more general setting the possibility of transferring pension benefits from the host to the source country or assume that b is positively related to the number of years of work in the source country, both elements would serve to deter guest workers from overstaying. For those who overstay nonetheless, their optimal duration of overstay would be shorter. This follows from the fact that international portability of pension benefits relaxes a guest worker's budget constraint, reducing her need to overstay,

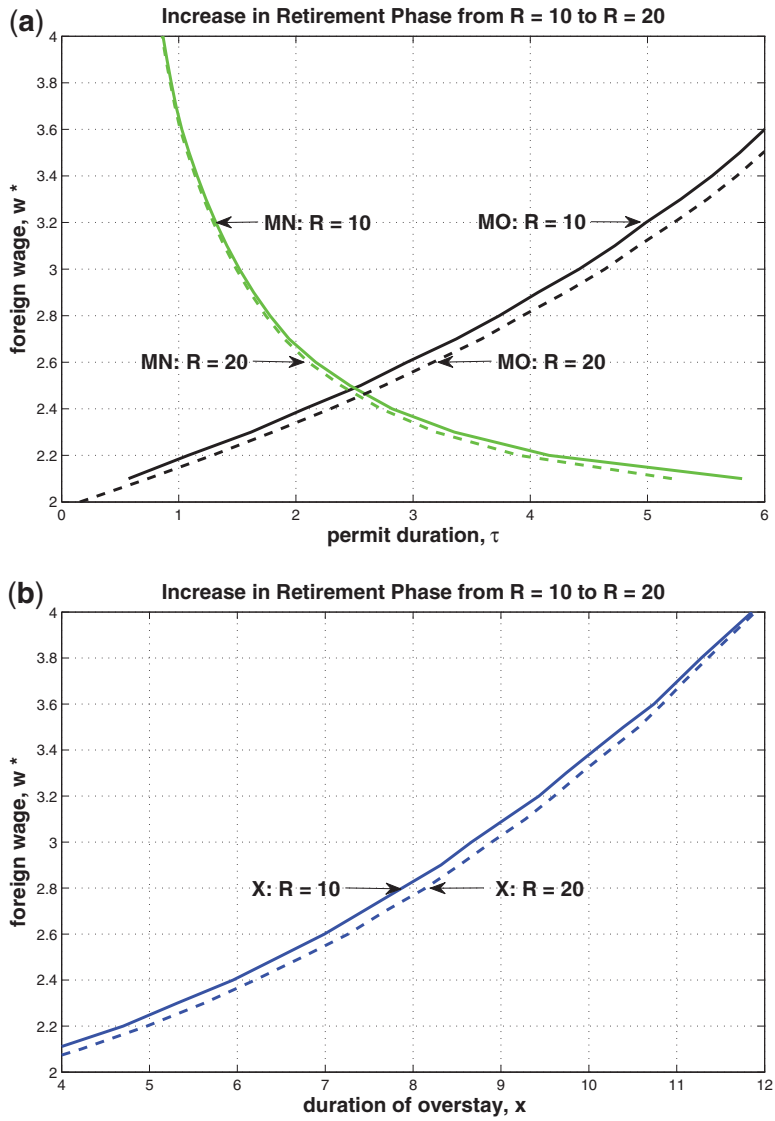

Figure 7 Longer retirement phase.

while a direct relationship between b and the number of years of work in the source country imposes an additional cost for overstaying abroad an instant longer (as an undocumented worker employed in H is unable to accumulate pension credits). This shortens the optimal duration of the overstay phase in the event a guest worker chooses not to return home at

the end of her contract. International agreements on the portability of pension benefits may therefore serve the host countries as a useful policy instrument in their fight against illegal immigration. From the point of view of a migrant (i) it increases the attractiveness of being a documented rather than an undocumented worker while abroad, as pension credits can be accumulated only in the formal sector and (ii) by providing a larger flow of retirement resources, it reduces a guest worker's incentive to overstay in the host country as an undocumented alien.[21]

5 Conclusions

The main objective of this article is to examine the role of immigration policies and the economic environment facing foreign workers in determining whether participants in a guest-worker program choose to overstay or to return voluntarily to their countries of origin at the end of their contract period. For parameter values that reflect typical economic and policy environments that the guest workers face in the host countries, an environment in which they would prefer to stay longer than allowed by the rules of the program, it is necessary for the authorities to provide an adequate incentive structure in order to achieve strict compliance. We consider in the present study the role of a salary-withhold scheme, a fine for overstaying, and employer sanctions that reduce the market wage of undocumented aliens. Tougher employer sanctions are shown to lower the incentive to remain in the host country beyond the expiration of the work permit and to encourage those who overstay to return relatively sooner to their country of origin. A higher salary withholding rate and a fine for overstaying also serve to discourage workers from overstaying. Should they nonetheless choose to stay beyond the expiration of the work permit, these policies actually induce the overstayers to remain in the host country for a *longer* period of time. This implies that increases in the salary withholding rate or in other forms of pecuniary penalties that fall short of being sufficient to guarantee strict compliance with the rules of program are counterproductive with respect to the goal of reducing the stock of undocumented aliens in the economy. They fail to

[21] A number of migrant-sending and -receiving countries have in fact bilateral social security agreements that provide for portability of contributions and entitlements of migrant workers and their families. The EU has been particularly active in establishing bilateral social security agreements with its neighbors. Note however that only around 1% of migrants in Africa and Asia are covered by bilateral agreements between the migrant-sending and -receiving country (Holzmann et al. 2005). By contrast, most of the migrants from Europe, North America, and Oceania work in countries with bilateral agreements.

reduce the flow of guest workers transiting to undocumented status, yet they increase the duration of the undocumented stay of those who do become illegal aliens. This effectively generates a larger equilibrium stock of undocumented workers. Thus, the salary withholding rate and overstay fine must be carefully designed in relation to the environment that guest workers face at home and abroad to be effective in *reducing* the stock of undocumented workers.

Lowering the cost of migration is found to make overstaying less attractive. Should some workers still choose to overstay, they will do so for a shorter period of time. Both a higher rate of return on investments at home and a larger cost-of-living differential between the host and the source country, help strengthen the incentives for strict compliance on the part of guest workers and shorten the optimal duration of an overstay, should the incentives for strict compliance prove to be insufficient. Retirement benefits at home also reduce the incentives for overstaying. Selecting guest workers from countries that offer their citizens more generous retirement benefits, that have relatively low price levels, and where returnees can enjoy high yields on repatriated savings, other things being equal, can help host countries lower the number of guest workers who overstay and reduce the optimal duration of the overstay phase for those who fail to comply with the rules of the program. Selection criteria that admit only guest workers with asset holdings above a certain minimum level also works in the same direction.

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A Appendix

A.1 A Guest Worker who Overstays

This Appendix examines in more detail the optimization problem facing a migrant who chooses to overstay in the host country. The Lagrangian can be written as follows:

$$L^{os} = \int_0^{\tau+x} \frac{(c_t^{*os})^{1-\theta}}{1-\theta} e^{-\delta t} dt + \int_{\tau+x}^{T+R} \frac{(c_t^{os})^{1-\theta}}{1-\theta} e^{-\delta t} dt + \lambda^{os} \Bigg\{ A_0 - K - \phi e^{-r^*(\tau+x)} + \int_0^{\tau} [w^*(1-\alpha) - p^* c_t^{*os}] e^{-r^* t} dt + \int_{\tau}^{\tau+x} [w^*(1-\sigma) - p^* c_t^{*os}] e^{-r^* t} dt + e^{-r^*(\tau+x)} \Bigg[\int_{\tau+x}^{T} [w - p c_t^{os}] e^{-r(t-\tau-x)} dt + \int_{T}^{T+R} [b - p c_t^{os}] e^{-r(t-\tau-x)} dt \Bigg] \Bigg\}, \tag{17}$$

The first-order conditions consist of the budget constraint (12) and:

$$\frac{\partial L^{os}}{\partial c_t^{*os}} = (c_t^{*os})^{-\theta} e^{-\delta t} - \lambda^{os} p^* e^{-r^* t} = 0, \tag{18}$$

$$\frac{\partial L^{os}}{\partial c_t^{os}} = (c_t^{os})^{-\theta} e^{-\delta t} - \lambda^{os} p e^{-rt+(r-r^*)(\tau+x)} = 0, \tag{19}$$

$$\frac{\partial L^{os}}{\partial x} = \left[\frac{(c_{\tau+x}^{*os})^{1-\theta}}{1-\theta} - \frac{(c_{\tau+x}^{os})^{1-\theta}}{1-\theta}\right] e^{-\delta(\tau+x)} +$$
$$+ \lambda^{os} e^{-r^*(\tau+x)} \{\phi r^* + w^*(1-\sigma) - p^* c_{\tau+x}^{*os} - w + p c_{\tau+x}^{os} - (r-r^*) A_{\tau+x}\} = 0, \tag{20}$$

where

$$A_{\tau+x} = -\left[\int_{\tau+x}^{T} [w - p c_t^{os}] e^{-r(t-\tau-x)} dt + \int_{T}^{T+R} [b - p c_t^{os}] e^{-r(t-\tau-x)} dt\right]$$

is the stock of assets repatriated by the migrant at $\tau + x$ to support his/her consumption over the remainder of the planning horizon. Equation (18) implies that, with $\delta = r^*$, the consumption rate abroad of a guest worker who chooses to overstay is constant at the rate $c^{*os} = (p^* \lambda^{os})^{-1/\theta}$, while eqs. (18) and (19) imply that his/her consumption rate after return to the source country is

$$c_t^{os} = c^{*os} (p^*/p)^{1/\theta} e^{(\frac{r-r^*}{\theta})(t-\tau-x)}, \quad t \in [\tau + x, T]. \tag{21}$$

For the duration of the overstay phase to be optimal, Equation (20) must hold. It states that the utility cost of overstaying an instant longer, as represented by the difference between the flow of utility enjoyed just after return and that enjoyed just before return, $\frac{(c_{\tau+x}^{os})^{1-\theta}}{1-\theta} - \frac{(c_{\tau+x}^{*os})^{1-\theta}}{1-\theta}$, must be equal to the net benefit. The latter consists of the utility value of the increase in the stock of assets held by the migrant as a result of overstaying an instant longer, as shown by the second term of Equation (20). There are several components here. First, by overstaying an instant longer, the migrant postpones the payment of the exit fine, ϕ, which contributes $r^*\phi$ to his/her asset holdings. Second, by overstaying an instant longer, the migrant is saving abroad rather than consuming in excess of income at home. This increases asset holdings by

$w^*(1-\sigma) - p^* c^{*os}_{\tau+x} - w + p c^{os}_{\tau+x}$. Finally, by overstaying an instant longer, the migrant earns the rate of return r^* (rather than r) on the stock of assets to be repatriated for the purpose of supporting consumption after return to S. This loss of interest is represented by $(r - r^*)A_{\tau+x}$ in the second term of Equation (20).

To understand the intuition of how various parameters of the model affect the optimal duration of the overstay phase, attention should be focused first on Equation (20), which gives an indication of the necessary change in consumption (and thus λ^{os}), such that the condition continues to hold and second, on the budget constraint, which dictates how long the migrant must overstay in order to meet the cost of the optimal time profile of consumption. These two conditions, along with what we know about the time path of consumption from eqs. (18) and (19), enable us to solve simultaneously for c^{*os} and x. Consider, for example, the case of a change in the wage penalty facing undocumented workers. For a given path of consumption and the duration of the overstay phase, an increase in σ reduces the saving rate and hence the benefit of overstaying an instant longer. To equate the cost and the benefit, consumption must fall to increase the marginal utility of consumption (λ^{os}) and hence the utility value of the benefit (i.e. savings generated by overstaying), to the point where Equation (20) is satisfied. A drop in consumption and the rise in σ, however, have opposite effects on the budget constraint. Lower consumption relaxes it, while lower earnings over the undocumented phase tighten it. For the parameter values used in the benchmark case and for any degree of concavity of the utility function, θ, that gives rise to an internal solution for x, the first effect dominates. That is, the optimal reduction in c^{*os} is sufficiently large such that a shorter duration of the overstay phase is required to simultaneously satisfy the budget constraint and Equation (20).

More formally, the simultaneous solution for c^{*os} and x is obtained as follows: with the aid of (21) and noting that $\lambda^{os} = \frac{(c^{*os})^{-\theta}}{p^*}$, we can express (20) as

$$\begin{aligned}
&\frac{(c^{*os})^{1-\theta}}{1-\theta}\left[1-\left(\frac{p^*}{p}\right)^{\frac{1-\theta}{\theta}}\right]+\frac{(c^{*os})^{-\theta}}{p^*}\left\{\phi r^* + w^*(1-\sigma) - w\right.\\
&-p^* c^{*os}\left[1-\left(\frac{p^*}{p}\right)^{\frac{1-\theta}{\theta}}\right]+(r-r^*)\left[w\frac{1-e^{-r(T-\tau-x)}}{r}\right.\\
&\left.\left.-p^* c^{*os}\left(\frac{p^*}{p}\right)^{\frac{1-\theta}{\theta}}\frac{e^{g(T+R-\tau-x)}-1}{g}+b\frac{e^{-r(T-\tau-x)}-e^{-r(T+R-\tau-x)}}{r}\right]\right\}\\
&=0, \qquad (22)
\end{aligned}$$

which enables us to write:

$$p^* c^{*os} = \frac{w\left[1 - \frac{(r-r^*)(1-e^{-r(T-\tau-x)})}{r}\right] - w^*(1-\sigma) - \phi r^* - (r-r^*)b\frac{1-e^{-rR}}{r}e^{-r(T-\tau-x)}}{\frac{\theta}{1-\theta}\left(1 - \left(\frac{p^*}{p}\right)^{\frac{1-\theta}{\theta}}\right) - (r-r^*)\left(\frac{p^*}{p}\right)^{\frac{1-\theta}{\theta}}\frac{e^{g(T+R-\tau-x)}-1}{g}}. \tag{23}$$

Using (21) in the budget constraint (12), we obtain the following:

$$p^* c^{*os} = \left\{ \begin{array}{l} A_0 - K - \phi e^{-r^*(\tau+x)} \\ + w^*\left[\dfrac{(1-\alpha)(1-e^{-r^*\tau}) + (1-\sigma)(e^{-r^*\tau} - e^{-r^*(\tau+x)})}{r^*}\right] \\ + e^{-r^*(\tau+x)}\left[w\dfrac{1-e^{-r(T-\tau-x)}}{r} + b\dfrac{1-e^{-rR}}{r}e^{-r(T-\tau-x)}\right] \end{array} \right\} \Bigg/ \left\{\frac{1-e^{-r^*(\tau+x)}}{r^*} + \left(\frac{p^*}{p}\right)^{\frac{1-\theta}{\theta}} e^{-r^*(\tau+x)}\frac{e^{g(T+R-\tau-x)}-1}{g}\right\}. \tag{24}$$

Finally, by equating (23) to (24), we can solve simultaneously for c^{*os} and the optimal return date, $\tau + x$, as functions of the model's parameters. Using these solutions in (11) yields the discounted welfare, V^{os}, of a guest worker who overstays in H until he/she finds it optimal to return to S. As an analytic solution is not available, we use numerical methods in analyzing our model in Sections 3 and 4.